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PhD: The Ohio State University, 1973

#### Professor of Engineering Physics

Professor Roh's research interest spans technology areas covering lasers, laser spectroscopy, and nonlinear optics. The applications of the technology areas include laser phasing and energy scaling, image processing, phase conjugation, frequency conversion, and optical diagnostics. He held a joint appointment with the Sensors Directorate of the Air Force Research Laboratory for 2000-2. He has advised 9 Ph.D. and 45 M.S. students during his 24 years on AFIT faculty, and published about 50 papers.

#### Staff Researchers

Dr. Sung-hyun Baek, Exchange Scientist

#### Student Researchers:

Capt Timothy H. Russell, PhD graduated  
Capt Brent W. Grime, PhD candidate  
2Lt Shawn M. Willis, MS Applied Physics  
2Lt Matthew B. Crookston, MS Applied Physics

#### Funding Sources:

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## Nonlinear Optics of Optical Fibers and its Application to High Energy Lasers

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#### Abstract:

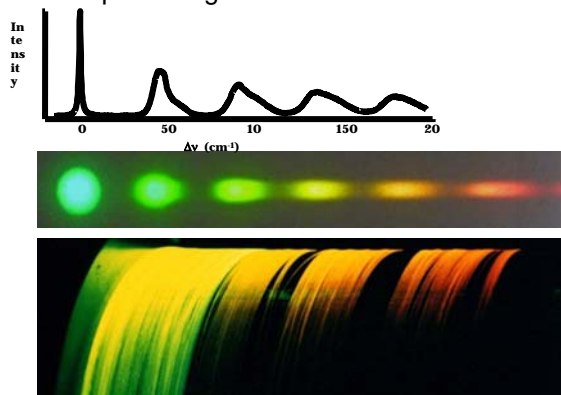
The objective of this research is to investigate nonlinear optical effects such as stimulated Raman scattering (SRS) and stimulated Brillouin scattering (SBS) in optical fibers and fiber lasers for applications in high-power laser designs, frequency shifting into the mid-infrared, and laser brightness scaling through beam phasing and combining. Properties of the above processes such as phase conjugation, frequency shifting, and beam cleanup are being exploited.

#### Research Methods:

The research is primarily experimental in nature. We study the basic physics of nonlinear optical processes of interest in laboratory scale experiments with an eye towards their ultimate application in practical system designs of high-energy laser systems.

#### Results:

Thus far we have successfully demonstrated laser brightness scaling through beam cleanup, beam combining using SBS and SRS in multi-mode fibers. We also demonstrated the feasibility of phasing multiple beams using a fiber phase conjugate mirror. As an example, note the beam cleanup properties of SRS in a multi-mode fiber can be seen from the smaller spot sizes of spectrally disburbed far-field spot profiles of various Stokes components generated in the fiber.



#### Publications:

T. H. Russell, S. Willis, M. Crookston, and W. B. Roh, "Stimulated Raman scattering in multi-mode fibers and its application to laser beam cleanup and combining," J. Nonlinear Optical Physics and Materials 11, 303-316 (2002).

T. H. Russell and W. B. Roh, "Threshold of second-order stimulated Brillouin scattering in optical fiber," J. Opt. Soc. Am. B 19, 2341-2345 (2002).

T. H. Russell, W. B. Roh, and J. R. Marciante, "Incoherent Beam Combining using Stimulated Brillouin Scattering in Multi-mode Fibers, Opt. Exprs. 8, 246-254 (2001), <http://www.opticsexpress.org>.